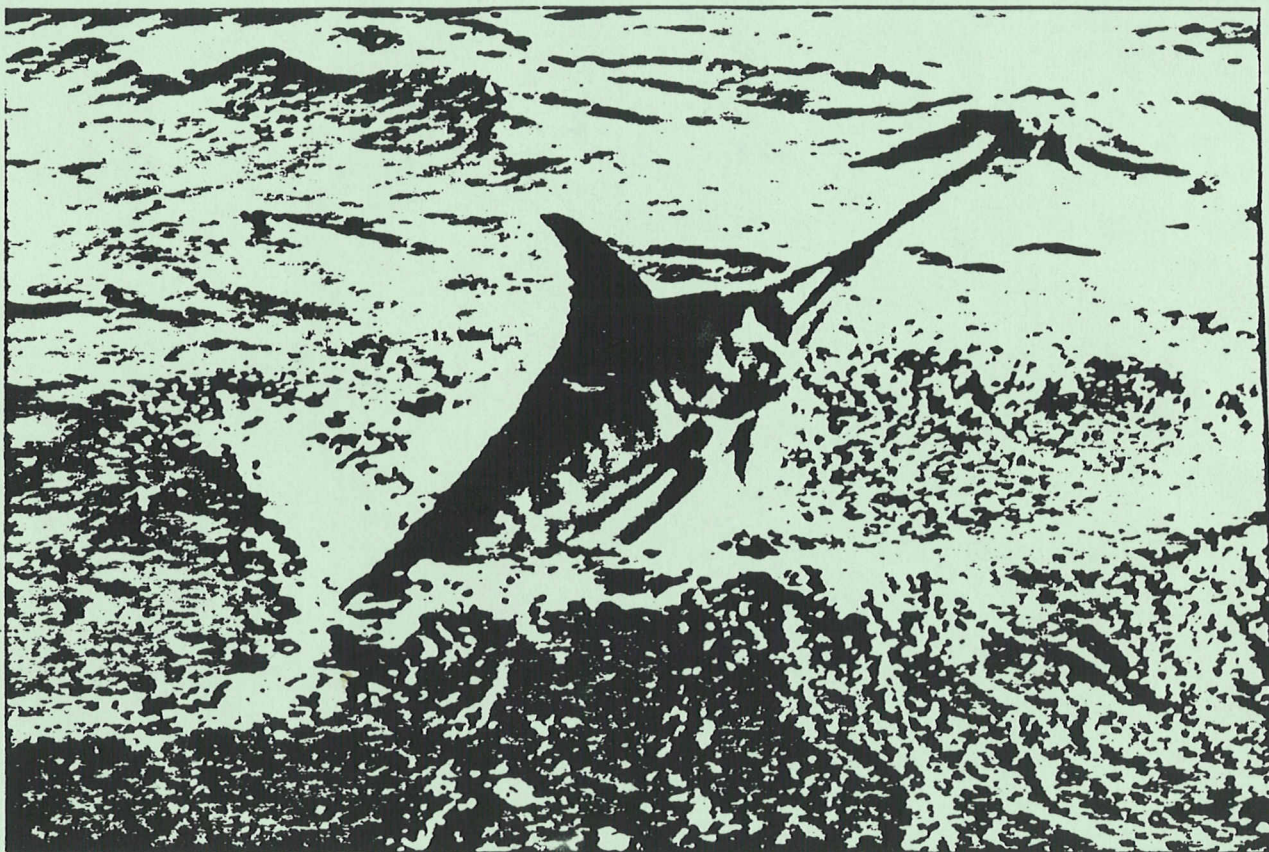




**1994/1995 REPORT OF THE SOUTHEAST  
FISHERIES SCIENCE CENTER  
BILLFISH PROGRAM**



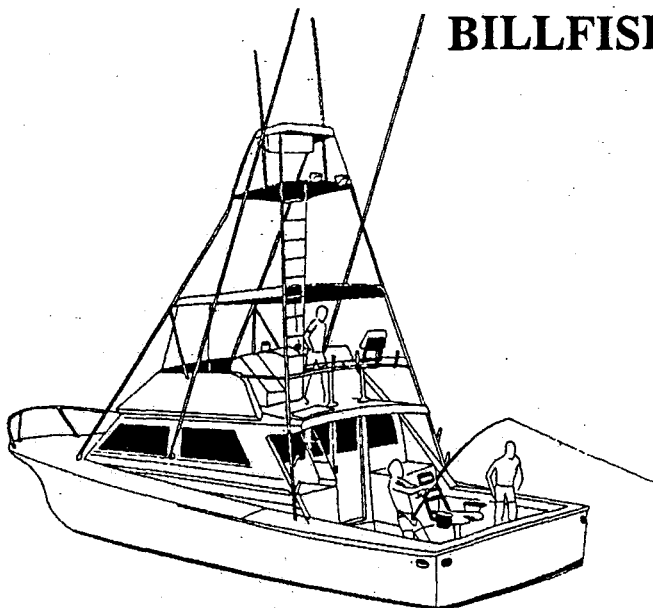
June 1997

U.S. Department of Commerce  
National Oceanic and Atmospheric Administration  
National Marine Fisheries Service  
Southeast Fisheries Science Center  
75 Virginia Beach Drive  
Miami, Florida 33149

# NOAA Technical Memorandum NMFS-SEFSC-398



## 1994/1995 REPORT OF THE SOUTHEAST FISHERIES SCIENCE CENTER BILLFISH PROGRAM



U.S. DEPARTMENT OF COMMERCE  
William Daley, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION  
D. James Baker, Under Secretary for Oceans and Atmosphere

NATIONAL MARINE FISHERIES SERVICE  
Rolland A. Schmitten, Assistant Administrator for Fisheries

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June 1997

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Contribution MIA-96/97-23 from the SEFSC, Miami Laboratory, Migratory Fishery Biology Division.

Copies may be obtained by writing:

Dr. Mark I. Farber  
National Marine Fisheries Service  
Southeast Fisheries Science Center  
75 Virginia Beach Drive  
Miami, Florida 33149

or  
National Technical Information Service  
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Springfield, Virginia 22161  
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Cover Photo: Estimated 175 lb blue marlin caught and released by Jim Edmiston aboard the *El Zorro* on the "North Drop" in the Virgin Islands. Note orange tag in fish.

This report was prepared with individual contributions from scientists at the Miami and Panama City Laboratories of the Southeast Fisheries Science Center

Compiled by  
**Mark I. Farber**

### INDIVIDUAL CONTRIBUTORS:

Cooperative Game Fish Tagging Program:

**Christopher D. Jones and David S. Rosenthal**

Cooperative Recreational Billfish Surveys:

**Mark I. Farber, Mike T. Judge, and Anna M. Avrigian**

ICCAT Enhanced Research Program for Billfish:

**Eric D. Prince and Thomas L. Jackson**

Pelagic Observer Program:

**Dennis W. Lee and Cheryl J. Brown**

## ACKNOWLEDGMENTS

The National Marine Fisheries Service (NMFS) is grateful to the recreational and commercial fishermen who voluntarily cooperated in the collection of billfish statistics, and to the numerous state, university, federal employees and private research organizations who lent their time and support to billfish programs. Additionally, we wish to thank those tournaments that provided NMFS samplers with transportation, hotel accommodations, and food. This assistance facilitated our being able to send NMFS scientists to personally attend their events in order to collect data and biological samples. We also recognize the cooperation of various international fisheries agencies who participated in the Enhanced Research Program for Billfish, conducted under the auspices of the International Commission for the Conservation of Atlantic Tunas (ICCAT).

## INTRODUCTION

Scientists at the Southeast Fisheries Science Center (SEFSC) have been involved in billfish research since the early 1970's. As a result, the SEFSC's billfish database is one of the most comprehensive sources of scientific information on Atlantic blue marlin, white marlin, sailfish, and spearfish. Many different segments of the fishing community - recreational anglers, commercial fishermen, representatives of billfish tournaments, university researchers, state agents, federal employees, and private research organizations - have donated their time, effort, data, and funds to assist our research program for more than two decades.

Billfishes and tunas are often referred to as "fish without a country" because their movement patterns encompass virtually the entire ocean and intersect the boundaries of many different nations. For example, very recent information indicates blue marlin make transatlantic, transequatorial, and even transoceanic movements. For this reason, this report provides a comprehensive presentation of research activities involving SEFSC scientists and includes work on Atlantic billfish that occurs outside, as well as inside, United States jurisdictional waters.

Most Atlantic billfish information is gathered through three Programs: the Cooperative Tagging Center (CTC) of the SEFSC; the Cooperative Recreational Billfish Survey (CRBS) of the SEFSC; and the Enhanced Research Program for Billfish (ERP) conducted under the auspices of the International Commission for the Conservation of Atlantic Tunas (ICCAT), located in Madrid, Spain. The original tagging program initiated in 1954 was comparatively narrow in scope and depended primarily on recreational anglers to tag tuna and billfish in the western Atlantic Ocean and Gulf of Mexico. This program has expanded to become the CTC which now documents many more target species, with greatly increased volunteer participation by all segments of the fishing community, as well as a cooperative data storage and data manipulation capability for state, international, and private tagging agencies Atlantic-wide. The purpose of the CRBS is to collect data on the number of billfish hooked, boated, tagged, and released during tournament and non-tournament fishing trips and to collect data on length, weight, and sex of individual billfish landed. The goal of the ERP is to collect the information that will lead to stock assessments of Atlantic billfishes, including: (1)

improve the Atlantic-wide biostatistical fishery database for billfish; (2) initiate and maintain an international Atlantic billfish tagging program; and (3) assist in age and growth research. Besides these three major programs for billfish, the tuna and swordfish research programs at the SEFSC also provide data on the number of billfish caught incidentally, and released in the U.S. and by foreign fishing vessels operating within U.S. jurisdictional waters. A review of the data collected from this program is also presented in a separate section: Pelagic Observer Program (POP).

This report includes data through 1995 from the CTC and the CRBS because data compilation for these programs are normally not completed until the mid-year following data collection.

## COOPERATIVE TAGGING CENTER

The National Marine Fisheries Service's (NMFS) Southeast Fisheries Science Center (SEFSC) formed the Cooperative Tagging Center (CTC) in 1992 in response to the recent expansion of tag release and recapture activities, data requests from other tagging agencies, and domestic and international tagging research needs. The CTC encompasses a variety of functions and responsibilities including volunteer and scientific tagging activities, as well as other research projects such as tag development and tag performance research.

The CTC provides tagging kits and related equipment free upon request to individual anglers. Each kit contains tags and self-addressed, postage paid tagging report cards and recapture cards to be filled out by the angler and returned to the CTC when fish are tagged or recaptured. Also included with the kit, and available free upon request, is the CTC annual newsletter. The newsletter provides more detailed information on all aspects of the billfish tagging program, along with information on other species targeted by the CTC. Interested persons may visit the CTC on the world wide web at:

<http://www.sefsc.noaa.gov/tag.html>

or contact

Cooperative Tagging Center  
Southeast Fisheries Science Center  
75 Virginia Beach Drive  
Miami, FL 33149  
(800) 437-3936



## Tag Releases

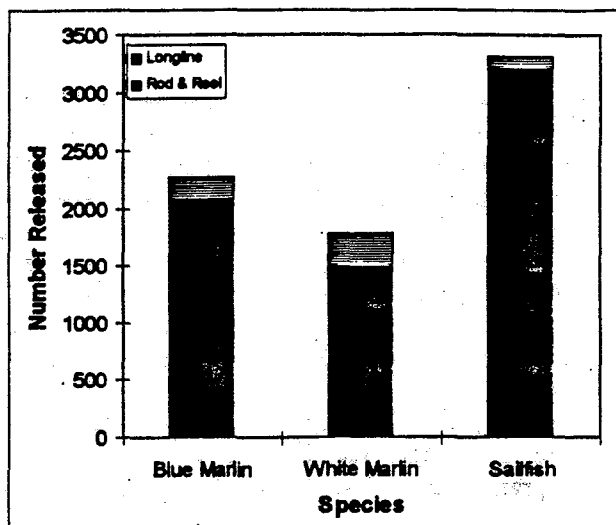
The number of tagged billfish reported to the NMFS Cooperative Tagging Center (CTC) by species, for the period January 1988 - October 1996, is presented in Table 1. This information does not necessarily agree with data previously published because tag releases are very often not reported until months, and sometimes years, after the fact. This can be a significant problem when a tag recapture report is submitted to the CTC before the tag release data. Additionally, these data do not include billfish tagged with tags from other organizations. For example, the South Carolina Marine Resources Department (SCMRD), the International Commission for the Conservation of Atlantic Tunas (ICCAT), and The Billfish Foundation (TBF) tagging programs have been playing an increasingly greater role in tagging billfish in recent years.

**Table 1.** Number of reported tagged billfish, by species, recorded in the NMFS Cooperative Tagging Center (CTC) database, 1988-1995, as of October, 1996.

<i>Year</i>	<i>Blue Marlin</i>	<i>White Marlin</i>	<i>Sailfish</i>	<i>Spearfish</i>
1988	1698	1112	2484	12
1989	2037	1214	2183	14
1990	2061	1286	3351	20
1991	1857	1452	3231	29
1992	1679	1182	3775	22
1993	1681	1472	2875	51
1994	1140	869	1824	29
1995	1135	906	1481	20

### Blue Marlin

A total of 2,223 blue marlin were tagged and released: 1,134 in 1994 and 1,089 in 1995. Of the total releases, 2,031 were released by recreational fishermen, 191 by commercial fishermen, and 1 by an unspecified source. The largest number of blue marlin tag releases (398) took place off the Virgin Islands. Other areas where blue marlin were tagged and released in large numbers were Puerto Rico (318), the Bahamas (232), Louisiana (207), La Guaira, Venezuela (174), and the U.S. east coast (150). The number of blue marlin tagged and released, by gear, are shown in Figure 1. These numbers do not necessarily correspond to the number of fish tagged by fishermen category.



**Figure 1.** Number of billfish tagged and released in 1994 and 1995, by gear type.

### White Marlin

A total of 1,765 white marlin were tagged and released: 866 in 1994 and 899 in 1995. Of the total releases, 1,469 were released by recreational fishermen, 281 by commercial fishermen, and 15 by unspecified sources. The largest number of white marlin tag releases (734) took place off the eastern U.S. Other areas where white marlin were tagged and released in large numbers were LaGuaira (324), northwest Florida (150), the western central Atlantic (81), and Texas (69). The number of white marlin tagged and released, by gear, are shown in Figure 1. These numbers do not necessarily correspond to the number of fish tagged by fishermen category.

### Sailfish

A total of 3,275 sailfish were tagged and released: 1,824 in 1994 and 1,451 in 1995. Of the total releases, 3,184 were released by recreational fishermen, 87 by commercial fishermen, and 4 by unspecified sources. As in previous years, a majority of sailfish tag releases (1,791) took place off the southeast coast of Florida. Other areas where sailfish were tagged in large numbers include Cancun, Mexico (316), the U.S. east coast (251), the western central Atlantic (185), Cozumel, Mexico, (180) and LaGuaira (132). The number of sailfish tagged and released, by gear, are shown in Figure 1. These numbers do not necessarily correspond to the number of fish tagged by fishermen category.

## Tag Recaptures

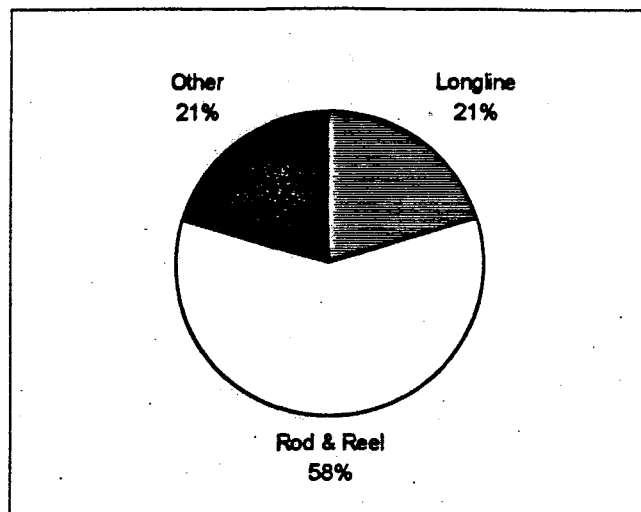
### Blue Marlin

There were 24 tagged blue marlin recaptured - 14 in 1994 and 10 in 1995 - 13 were recaptured by recreational fishermen, 4 by longline commercial fishermen, 3 by gillnet commercial fishermen, 1 by handline, and 3 by gear not reported. The release and recapture locations of recaptured blue marlin are given in Table 2, and the percentages recaptured by gear are shown in Figure 2.

The longest minimum straight line distance traveled (a minimum estimate of movement which provides no insight into the true route taken) by a recaptured blue marlin was 1,531 nm. The fish was released off St. Lucia in the Caribbean and recaptured 140 days later off Ocean City, MD. The longest time at-large for a recaptured blue marlin was 3,042 days. This fish was released 10/16/85 off LaGuaira and recaptured near the same location on 2/13/94.

**Table 2.** Known release and recapture location for 21 blue marlin recaptured during 1994 and 1995.

Release Location	Recapture Location	Total
BERMUDA	BERMUDA	1
LAGUAIRA, VEN.	HISPANIOLA	1
	LAGUAIRA, VEN.	6
LOUISIANA	GULF OF MEXICO	1
ST. LUCIA	U.S. MID-ATLANTIC	1
NORTHERN BAHAMAS	MARTINIQUE	1
	N. FLORIDA	1
EASTERN ATLANTIC	EASTERN ATLANTIC	1
PUERTO RICO	HISPANIOLA	2
TEXAS	TEXAS	1
VENEZUELA	U.S. MID-ATLANTIC	1
VIRGIN ISLANDS	PUERTO RICO	1
	VIRGIN ISLANDS	1
	WESTERN ATLANTIC	1
WESTERN ATLANTIC	CUBA	1



**Figure 2.** Percentage of tagged blue marlin recaptured in 1994 and 1995, by gear type.

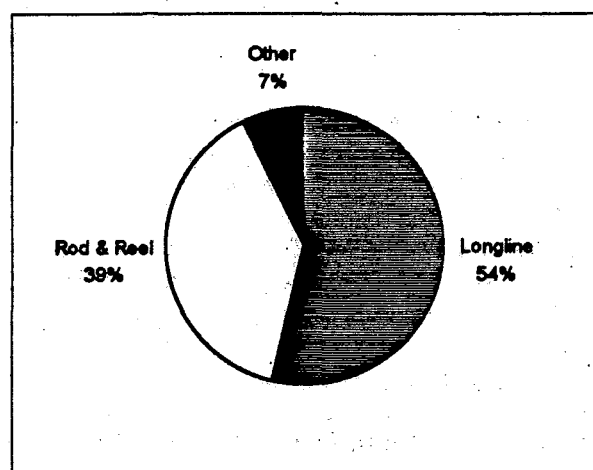
### White Marlin

There were 45 tagged white marlin recaptured - 29 in 1994 and 16 in 1995 - 22 were recaptured by recreational fishermen, 19 by longline commercial fishermen, and 4 by gear not reported. The release and recapture locations of recaptured white marlin are given in Table 3, and the percentages recaptured by gear are shown in Figure 3.

The longest minimum straight line distance traveled (a minimum estimate of movement which provides no insight into the true route taken) by a recaptured white marlin was 2,482 nm. The fish was released off Cozumel, Mexico and recaptured 286 days later in the central Atlantic. The longest time at-large for a recaptured white marlin was 2,595 days. This fish was released 4/23/88 off Hispaniola and recaptured 6/23/94 near LaGuaira.

**Table 3. Known release and recapture locations for 44 white marlin recaptured during 1994 and 1995.**

Release Location	Recapture Location	Total
CANCUN, MEXICO	WESTERN ATLANTIC	1
FLORIDA NORTHWEST	SOUTHEAST FLORIDA	1
HISPANIOLA	LAGUAIRA, VEN.	1
LAGUAIRA, VEN.	CUMANA, VEN.	5
	LAGUAIRA, VEN.	5
	VENEZUELA	3
U.S. MID-ATLANTIC	CUMANA, VEN.	4
COAST	LAGUAIRA, VEN.	2
	U.S. ATLANTIC COAST	13
	EASTERN ATLANTIC	1
	WESTERN ATLANTIC	3
NORTHERN BAHAMAS	CUMANA, VEN.	1
	LAGUAIRA, VEN.	1
SOUTHEAST FLORIDA	PUERTO RICO	1
TEXAS	TEXAS	1
WESTERN ATLANTIC	WESTERN ATLANTIC	1



**Figure 3. Percentage of tagged white marlin recaptured in 1994 and 1995, by gear type.**

#### Sailfish

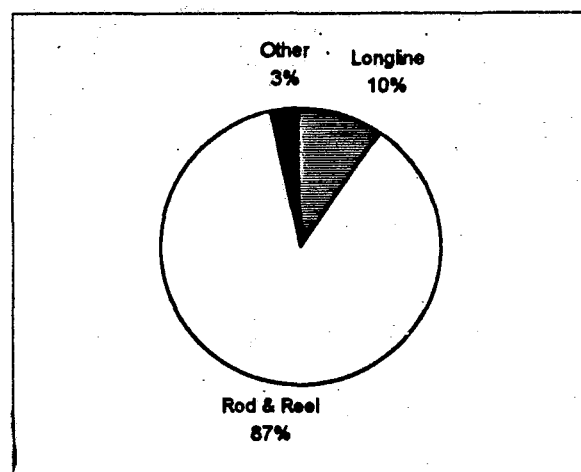
There were 114 tagged sailfish recaptured - 74 in 1994 and 40 in 1995 - 102 were recaptured by recreational fishermen, 7 by commercial fishermen, and 5 by gear not reported. The release and recapture locations of recaptured sailfish are given in Table 4 and the percentages recaptured by gear are shown in Figure 4.

The longest minimum straight line distance traveled (a minimum estimate of movement which provides no insight into the true route taken) by a recaptured sailfish was 1,503 nm. The fish was released off Cancun, Mexico, and recaptured 236 days later off the island of Grenada. The longest time at-large for a recaptured sailfish was 1,854 days for a fish

released 12/27/88 off Islamorada, FL and recaptured off Islamorada on 1/24/94.

**Table 4. Known release and recapture location for 113 sailfish recaptured during 1994 and 1995.**

Release Location	Recapture Location	Total
BARBADOS	LAGUAIRA, VEN.	2
CANCUN, MEXICO	CANCUN, MEXICO	2
	GRENADA	1
	MEXICO	1
	NORTHERN BAHAMAS	1
COZUMEL, MEXICO	CANADA	1
	CUBA	2
	CUMANA, VEN.	1
	U.S. ATLANTIC COAST	1
GULF OF MEXICO	SOUTHEAST FLORIDA	1
LAGUAIRA WATERS	BARBADOS	1
	GRENADA	1
U.S. ATLANTIC COAST	CANCUN, MEXICO	1
	SOUTHEAST FLORIDA	1
N. FLORIDA AND CAROLINAS	CUBA	1
	JAMAICA	1
	NORTHERN BAHAMA	1
	SOUTHEAST FLORIDA	6
WESTERN ATLANTIC	SOUTHEAST FLORIDA	1
PUERTO RICO	SOUTHEAST FLORIDA	1
SOUTHEAST FLORIDA	CUBA	1
	GRENADA	1
	GULF OF MEXICO	2
	LAGUAIRA, VEN.	1
	WESTERN ATLANTIC	2
	SOUTHEAST FLORIDA	78



**Figure 4. Percentage of tagged sailfish recaptured in 1994 and 1995, by gear type.**

## TAG DEVELOPMENT and DOUBLE TAGGING RESEARCH

### Tag Development and Performance

The NMFS Miami Laboratory Cooperative Tagging Center (CTC) introduced a new tag in 1995. This new tag design, the HM-tag, is similar to The Billfish Foundation (BF-type) tag. The HM-tag (HM stands for Highly Migratory) is constructed of medical-grade nylon and uses a stainless steel applicator for tag placement which is withdrawn, leaving only the nylon anchor inside the fish. The HM-tag is designed as an intermuscular tag and has replaced the R-type stainless steel tag. Improvements incorporated into the HM-tag are based on the double-tagging observations outlined in the next section.

Of historic significance was the first documented trans-Atlantic movement of a swordfish that was recorded in 1995 using an HM tag. This HM tag was placed into the swordfish off Wilmington Canyon and recaptured 390 days later off Spain.

The CTC, in conjunction with the Gulf Coast Research Lab in Ocean Springs, MS, is also examining changes in the tissue response over time using medical-grade nylon tags. Because billfish cannot be held in captivity, red drum and red snapper were used for the study. By using medical-grade nylon for the anchor tip we hope to reduce the rejection of the tag by the fish, thereby potentially increasing its biological compatibility. While there have been few preliminary studies to confirm this affect with fish muscle, it has gained widespread acceptance in the bio-medical arena for use in human surgical implants. From this experiment, we found significantly lower shedding rates of the new tag, compared to the most widely used tag available for small, inshore species.

### Double-Tagging

The tagging procedures for the double tagging study are more demanding than the procedures used in the conventional tagging program. Therefore, double tagging using the NMFS R-tag, the NMFS HM-tag or The Billfish Foundation BF-tag is not for everyone and we prefer that only the more experienced taggers attempt this activity. For example, when double tagging, we prefer to have one tag placed on each side of the billfish. This would greatly increase the probability that a tag on a

recaptured fish would be seen when brought alongside the boat. However, tagging on both sides of the fish takes longer and is not always possible under field conditions. Some of the more innovative participants in this experiment have built tagging sticks that insert both tags into the fish at the same time. Although this simplifies the tagging procedure and saves time, we discourage this practice because having both tags on one side of the fish close enough to touch each other invalidates the purpose of the experiment. That is, under these conditions the shedding rates of the two tags are not independent of each other.

To date, there has been a total of 2,879 double-tagged billfish released and 38 (about 1.3%) of these have been recaptured (Table 5). The majority of the double-tagging has been with blue marlin and sailfish, but significant numbers of white marlin, spearfish, and swordfish have also been double-tagged. Both the commercial participants and recreational anglers have participated actively in the double-tagging program. Of the 38 recaptured fish, 19 had both tags intact, while 19 had only the TBF tag - the NMFS R-tag (stainless steel tip) was apparently shed in 19 fish. Because the total number of double-tagged billfish recaptured has been so low, definitive conclusions from these preliminary results are not possible. We greatly appreciate the efforts of recreational anglers and commercial participants for their contributions to the double-tagging program, recognizing that more effort is required to properly double tag.

Table 5. Summary of double-tagging experiments conducted jointly by The Billfish Foundation and the NMFS CTC.

Species	Releases	Recaptures
Sailfish	901	19
Blue Marlin	946	6
White Marlin	404	8
Swordfish	573	5
Black Marlin*	12	0
Striped Marlin*	27	0
Spearfish	16	0
TOTAL	2879	38

\* Pacific Ocean releases



## COOPERATIVE RECREATIONAL BILLFISH SURVEY (CRBS)

The Cooperative Recreational Billfish Survey (CRBS) of the SEFSC documented a total of 81,261 hours of fishing effort from 111 tournament locations throughout the western North Atlantic, Gulf of Mexico, and Caribbean Sea in 1994 (Figure 6). In 1995, the CRBS documented a total of 88,319 hours of fishing effort from 120 tournament locations throughout the western North Atlantic, Gulf of Mexico, and Caribbean Sea (Figure 6). The hours sampled by the survey, or voluntarily submitted to NMFS, represent an unknown fraction of the total hours fished by the many recreational anglers who target billfish in the Atlantic, Gulf of Mexico, and Caribbean Sea.

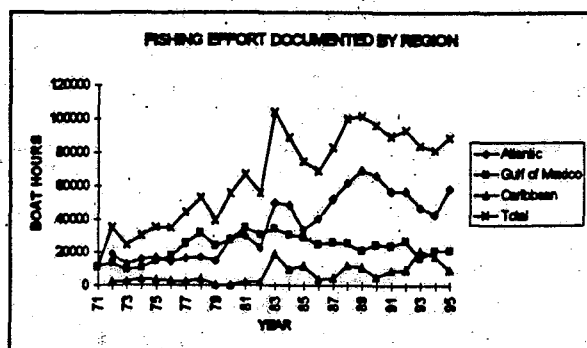


Figure 6. Yearly fishing hours documented by region by the cooperative recreational billfish survey and for all areas combined, 1971-1995.

A total of 3,682 billfish (1,436 blue marlin, 812 white marlin, 1,430 sailfish, and 4 spearfish) were reported caught (i.e., boated, released, or tagged) in 1994, of which 3,293 (89.4%) were released (Figure 7). The percentage of all billfish caught in 1994, by area, as documented by the survey, was: U.S. East Coast - 19.1%; Gulf of Mexico - 15.6%; Florida East Coast and Keys - 36.0%; Caribbean - 17.7%, and Bahamas - 11.6%. In 1995, a total of 4,260 billfish (1,168 blue marlin, 803 white marlin, 2,284 sailfish, and 5 spearfish) were reported caught (i.e., boated, released, or tagged), of which 3,928 (92.2%) were released. The percentage of all billfish caught in 1995, by area, as documented by the survey, was: U.S. East Coast - 18.7%; Gulf of Mexico - 14.4%; Florida East Coast and Keys - 49.5%; Caribbean - 6.0%; and Bahamas - 11.4%.

The proportion of billfish released has generally increased for all three species (Figure 7), particularly over the last 10 years. This coincides with a progressive increase in conservation fishing ethics

which has been self-imposed by the U.S. recreational billfishing community for more than a decade. In addition, the U.S. Fishery Management Plan for Atlantic Billfishes, enacted in 1988, also encourages releasing by imposing minimum size limits for each species of billfish (except for spearfish). These minimum sizes (in lower-jaw-fork-length) are: blue marlin - 86 in; white marlin - 62 in; and sailfish - 57 in. These restrictions tend to increase the average size of fish landed, thus discrediting comparisons of average sizes before and after 1988.

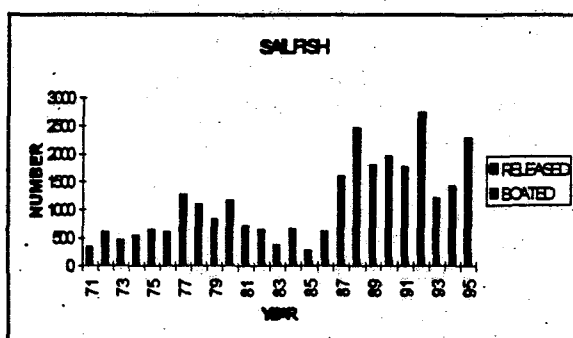
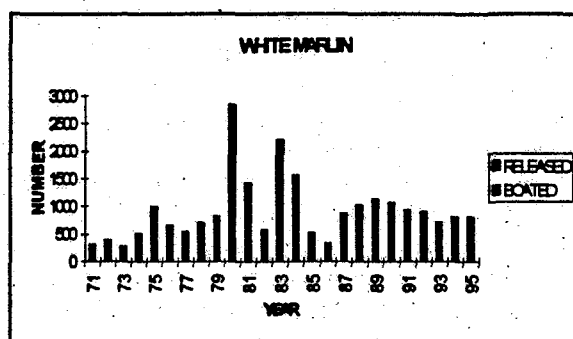
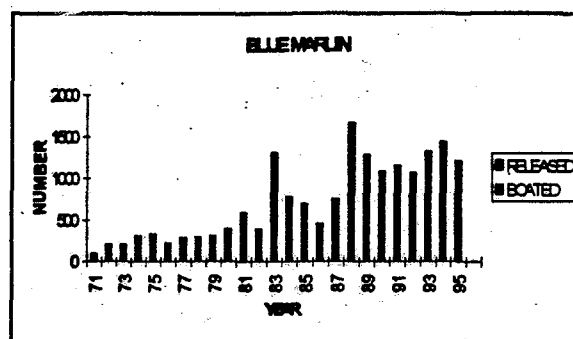


Figure 7. Numbers of billfish released or boated, from all areas combined, for blue marlin, white marlin, and sailfish, 1971-1995, as documented by the NMFS Cooperative Recreational Billfish Survey.

### Average and Maximum Sizes

Only a portion of all billfish landed are actually measured, weighed, and sexed by survey personnel because of the strong release policies, large minimum

sizes, and limited number of tournaments sampled by the NMFS staff. The overall average weight of blue marlin, white marlin, and sailfish reported from our survey in 1994 was 353.3, 57.0, and 41.8 lbs, respectively. The largest blue marlin recorded during the 1994 survey weighed 920.0 lbs and was landed in The Bahamas in June at the Boat Harbour Championship onboard the *Lady Sara*. The largest white marlin reported in 1994 was caught by the *Loose Goose* in August at the White Marlin Open in Ocean City, MD, and weighed 77.5 lbs. The largest sailfish weighed 58 lbs and was reported from the Boat Harbour Championship in The Bahamas in June by the *Rebel IV*.

In 1995, the overall average weight of blue marlin, white marlin, and sailfish reported from our survey was 367.5, 56.8, and 45 lbs, respectively. The largest blue marlin recorded during the 1995 survey weighed 800.0 lbs and was landed in The Bahamas in April at the North Abaco Championship onboard the *Gun Moll*. The largest white marlin reported in 1995 was caught by the *Exodus* in June at the Pensacola International Billfish Tournament in Pensacola, FL, and weighed 90.3 lbs. The largest sailfish weighed 73.8 lbs and was reported from the Deep Sea Round Up in Port Aransas, TX in July by the *First Strike*.

#### Catch-Rates and Fishing Effort

A measure of estimated relative abundance of billfish is computed from the number of fish caught per 100 hrs of fishing effort (i.e., trolling). In past reports we often presented hooked-per-unit-effort (HPUE) data for billfish. Although HPUE data have been considered by some scientists to be more desirable than catch-per-unit-effort (CPUE) data as an index of relative abundance for billfish, present stock assessment models use CPUE data because only this information is available for most areas outside U.S. waters. Therefore, CPUE information is emphasized in this report. In general, yearly fluctuations in CPUE's can reflect changes in intensity of our sampling program, angling technique, as well as habitat and environmental changes. Therefore, variations in catch-rates reported among years might not reflect true changes in stock abundance or availability.

The overall CPUE, for all areas combined, in 1994 for blue marlin, white marlin, and sailfish was 1.8, 1.0, and 1.8 fish per 100 hrs, respectively. Mean catch-rates indicate that since 1971, the average

CPUE for blue marlin is 1.2, for white marlin is 1.7, and for sailfish is 2.1 fish per 100 hrs (Figure 8).

In 1995, the overall CPUE, for all areas combined for blue marlin, white marlin, and sailfish was 1.5, 0.7, and 2.4 fish per 100 hrs, respectively. Mean catch-rates indicate that since 1971, the average CPUE for blue marlin is 1.2, for white marlin is 1.7, and for sailfish is 2.1 fish per 100 hrs (Figure 8). An inherent problem in calculating sailfish CPUE (especially for the Florida East Coast and Keys area) is the lack of separation of the type of fishing effort data; i.e., trolling versus live-baiting. This is discussed in more detail below.

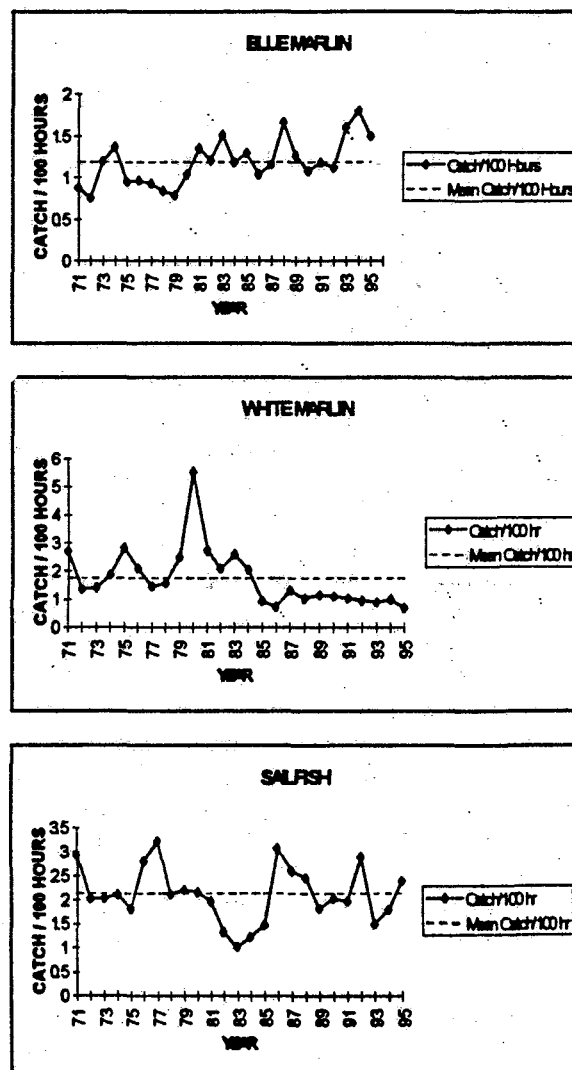


Figure 8. Catch per 100 hours of fishing effort for blue marlin, white marlin, and sailfish, 1971-1995, as recorded by the Cooperative Recreational Billfish Survey.

### **U.S. East Coast (North of Florida)**

*Much of the following information was provided through our volunteer program, and we thank all those individuals and organizations who contributed data.*

A total of 15,765 hrs of fishing effort was sampled from 19 tournaments from Cape Cod, MA, to Savannah, GA in 1994 (Table 7). Catch-rates reported in this area in 1994 for blue marlin, white marlin, and sailfish were 0.6, 3.7, and 0.2 fish per 100 hrs, respectively, changing little from 0.9, 2.7, and 0.2 fish per 100 hrs recorded in 1993. The associated catch reported in 1994 from this area (Table 8) was 702 billfish (92 blue marlin, 578 white marlin, and 32 sailfish), of which 622 (i.e., 88%) were released.

In 1995, a total of 24,055 hrs of fishing effort was sampled from 27 tournaments from Cape Cod, MA, to Savannah, GA (Table 7). In 1995, catch-rates reported for blue marlin, white marlin, and sailfish were 0.6, 2.4, and 0.3 fish per 100 hrs, respectively. In 1995, the associated catch reported from this area (Table 8) was 797 billfish (151 blue marlin, 570 white marlin, 74 sailfish and 2 spearfish), of which 733 (i.e., 92%) were released.

Monthly CPUE calculations for 1994 and 1995 indicated highest overall CPUE values for blue marlin and sailfish occurred in June, while CPUE values were highest for white marlin in September.

### **Florida East Coast and Keys**

Along the Florida East Coast and Keys, a total of 14,139 hrs of fishing effort were reported in 1994. The documented breakdown was 5,079 hrs trolling and 9,060 hrs live-baiting. The associated catch reported in this area (Table 8) was 1,324 billfish (1,314 sailfish, 7 blue marlin, and 3 white marlin), of which 1,319 (i.e., 99.6%) were released. Over 99% of the billfish caught in this area were sailfish. Catch-rates in 1994 for both blue marlin and white marlin were 0.0 fish per 100 hrs. The catch-rate in 1994 for sailfish was 9.3 fish per 100 hrs, compared with 6.6 fish per 100 hrs reported in 1993.

In 1995, the Florida East Coast and Keys reported a total of 18,566 hrs of fishing effort. The documented breakdown was 8,009 hrs trolling and 10,557 hrs live-baiting. The associated catch reported in this area (Table 8) was 2,110 billfish (2,103 sailfish, 5 blue marlin, 1 white marlin, and 1 spearfish), of which 2,092 (i.e., 99%) were released. Over 99% of

the billfish caught in this area were sailfish. In 1995, catch-rates for both blue marlin and white marlin were 0.0 fish per 100 hrs. The catch-rate for sailfish increased in 1995 to 11.3 fish per 100 hrs.

The live-baiting effort is generally associated with targeting sailfish. However, sailfish were also caught when the fishing effort was trolling. During any given fishing day, a boat could troll part of the day and live-bait part of the day. Further, for some fishing events, data are reported as the total number of boats fishing, the total number of hours fished, and the resulting catch and release by species. Hence, the type of fishing effort for sailfish are often very difficult, if not impossible, to separate. Therefore, as noted above, changes in sailfish CPUE reported here (Figure 8) may not be representative of changes in stock abundance.

### **Bahamas**

In the Bahamas, 12,823 hrs of fishing effort from 11 tournaments was sampled in 1994 (Table 7). Of this total, 6,116 hrs (48%), were reported from the five tournaments in the Bahamas Billfish Championship Series. Catch-rates for blue marlin, white marlin, and sailfish in 1994 were 2.9, 0.3, and 0.2 fish per 100 hrs, respectively, changing little from 2.8, 0.4, and 0.2 reported in 1993. The associated catch in 1994 from this area (Table 8) was 426 billfish (366 blue marlin, 38 white marlin, and 22 sailfish), of which 373 (i.e., 88%) were released.

In 1995, the CRBS reported 15,490 hrs of fishing effort from 13 tournaments in the Bahamas (Table 7). Of this total, 7,488 hrs (48%), were reported from the five tournaments in the Bahamas Billfish Championship Series. In 1995, catch-rates for blue marlin, white marlin, and sailfish were 2.7, 0.4, and 0.1 fish per 100 hrs, respectively, changing little from 2.9, 0.3, and 0.2 reported in 1994. In 1995, the associated catch from the Bahamas (Table 7) was 486 billfish (417 blue marlin, 56 white marlin, and 13 sailfish), of which 430 (i.e., 88%) were released.

### **Caribbean**

The Caribbean survey documented 17,456 hrs of fishing effort from 16 tournaments (of which 12 were from Puerto Rico) in 1994 (Table 7). Catch-rates for blue marlin, white marlin, and sailfish reported in 1994 were 3.8, 0.0, and 0.0 fish per 100 hrs, respectively, compared with 3.1, 0.0, and 0.8 fish per 100 hrs reported in 1993. The associated catch in 1994 from this area (Table 8) was 657

billfish (656 blue marlin and 1 white marlin), of which 562 (i.e., 86%) were released.

In 1995, the Caribbean survey documented 9,246 hrs of fishing effort from 12 tournaments, all from Puerto Rico (Table 7). In 1995, catch-rates for blue marlin, white marlin, and sailfish were 2.7, 0.0, and 0.0 fish per 100 hrs, respectively, compared with 3.8, 0.0, and 0.0 fish per 100 hrs reported in 1994. In 1995, the associated catch from this area (Table 8) was 255 billfish (252 blue marlin, 1 white marlin, and 2 sailfish), of which 214 (i.e., 84%) were released.

#### **Gulf of Mexico**

Throughout the billfishing tournament season (May through September) port samplers conduct interviews with the anglers at tournament sites in the northern Gulf of Mexico to collect data on billfishing catch and effort, techniques, and baits. Analyses are generally summarized for the northwestern (NW), northcentral (NC), and northeastern (NE) regions of the Gulf of Mexico.

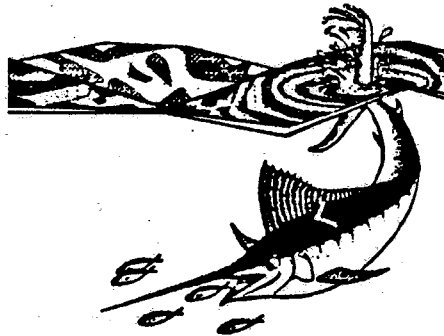
There were 21,078 hrs effort sampled in 49 tournaments in the northern Gulf of Mexico during the 1994 season (Table 7). There were approximately 13% more effort recorded in the northern Gulf of Mexico for both the 1994 and 1995 seasons than were sampled in 1993. A total of 721 billfishes (403 blue marlin, 237 white marlin, and 81 sailfish) were reported caught in 1994 (Table 8). These numbers of billfishes include landings data where no effort was recorded, and landings data with effort using methods of fishing other than trolling (i.e. driftfishing and livebaiting). In 1994, the northeastern Gulf reported 10,466 hrs of effort with a catch rate of 2.1 billfish per 100 hr effort; the northcentral Gulf reported 5,766 hrs of effort with a catch rate of 2.2 billfish per 100 hr effort; and the

northwestern Gulf reported 4,846 hrs of effort with a catch rate of 4.6 billfish per 100 hrs effort.

The catch rate in 1994, compared to 1993, increased in every region: NE up 0.4 billfish per 100 hrs effort; NC up 0.8 billfish per 100 hrs effort; and NW up 1.2 billfish per 100 hrs effort.

In 1995, there were 20,962 hrs effort sampled in 51 tournaments in the northern Gulf of Mexico (Table 7). A total of 660 billfishes (388 blue marlin, 178 white marlin, and 94 sailfish) were reported as caught in 1995 (Table 8). These numbers of billfishes include landings data where no effort was recorded, and landings data with effort using methods of fishing other than trolling (i.e. driftfishing and livebaiting). The livebait and drifting effort account for less than 2% of the total effort in either the 1994 or 1995 seasons. In 1995, the northeast Gulf reported 9,824 hrs of effort with a catch rate of 2.1 billfish per 100 hr effort; the northcentral Gulf reported 6,342 hrs of effort with a catch rate of 2.6 billfish per 100 hr effort; and the northwest Gulf reported 4,796 hrs of total effort with a catch rate of 4.8 billfish per 100 hr effort.

Since 1993, releases for the Gulf of Mexico have exceeded 75% of the annual recreational catch. By region, the northcentral Gulf of Mexico released the highest percentage of the catch for both 1994 (91%), and 1995 (93%); the northwest area released 76% of the catch in 1994 and 72% in 1995; and the northeast Gulf of Mexico released 64% of the catch in 1994 and 65% in 1995. These high release rates indicate a genuine concern for the resource by sport anglers as well as enactment of various state and federal management laws.



**Table 7.** The number of trolling hours (effort) documented by the NMFS Recreational Billfish Survey from 1988 through 1995, by areas: Atlantic north of Florida; Florida East Coast and the Keys; northeastern Gulf of Mexico (east of Alabama/Mississippi border); northcentral Gulf (Louisiana/Texas border east to the Alabama/Mississippi border); northwestern Gulf (Texas coast); The Bahamas; and the Caribbean. During 1988-1992 non-tournament data were included in the Gulf of Mexico survey.

Area	1988	1989	1990	1991	1992	1993	1994	1995
Atlantic N. of Fla.	21,183	27,436	27,771	25,575	27,161	21,449	15,765	24,055
Fla. East Coast & Keys	26,056	26,467	23,769	21,131	19,530	14,598	14,139	18,566
Northeast Gulf of Mexico	12,999	11,530	13,975	13,089	13,289	8,276	10,466	9,824
Northcentral Gulf of Mexico	7,843	5,873	6,630	7,113	8,273	4,780	5,766	6,342
Northwest Gulf of Mexico	4,833	3,710	3,997	3,596	5,263	3,295	4,846	4,796
Bahamas	14,427	15,032	14,679	9,936	10,749	10,659	12,823	15,490
Caribbean	12,218	11,043	5,252	9,017	9,513	20,799	17,456	9,246
TOTALS:	99,559	101,091	96,073	89,457	93,778	83,856	81,261	88,319

**Table 8.** The number of billfish caught associated with the trolling hours documented (Table 7) by the NMFS Recreational Billfish Survey from 1988 through 1995, by areas: Atlantic north of Florida; Florida East Coast and the Keys; northeastern Gulf of Mexico (east of Alabama/Mississippi border); northcentral Gulf (Louisiana/Texas border east to the Alabama/Mississippi border); northwestern Gulf (Texas coast); The Bahamas; and the Caribbean. During 1988-1992, non-tournament data were included in the Gulf of Mexico survey. Caught fish are those that were boated, released, or tagged and released.

Area	1988	1989	1990	1991	1992	1993	1994	1995
Atlantic N. of Fla.	748	959	1,040	775	915	828	702	797
Fla. East Coast & Keys	2,240	1,706	2,023	1,659	1,962	964	1,324	2,110
Northeast Gulf of Mexico	488	237	276	223	287	137	277	217
Northcentral Gulf of Mexico	205	92	110	145	132	66	185	210
Northwest Gulf of Mexico	216	134	142	119	210	115	259	233
Bahamas	390	404	323	291	294	355	426	486
Caribbean	853	718	383	666	904	827	657	255
TOTALS:	7,128	6,239	6,287	5,869	6,696	5,285	5,824	6,303

## ICCAT RELATED ACTIVITIES

### The 1995 and 1996 ICCAT Standing Committee on Research and Statistics (SCRS) Report on Billfish

During the 1995 and 1996 meetings of the ICCAT Standing Committee on Research and Statistics (SCRS) in Madrid, Spain, scientists from the Miami Laboratory presented numerous working documents pertaining to billfish research activities. Farber et al. (SCRS/95/105) presented an exploratory stock-production model analysis of sailfish in the eastern Atlantic Ocean. This document presented the first attempt at using a non-equilibrium production model approach to assessing the stock status of East Atlantic sailfish. The authors concluded that caution should be used in drawing conclusions due to uncertainties and potential violations of assumptions within the data series used. Future work is needed in

standardizing the CPUE's from the major East Atlantic fisheries. Adams (SCRS/95/106) summarized the historical CPUE of the recreational fishery for billfish in the U.S. Virgin Islands, particularly from St. Croix. Prince (SCRS/95/107) summarized progress of the ICCAT Enhanced Research Program for Billfish during 1995. Major areas of activity included at-sea sampling, shore-based sampling, and retrieval of tag-recaptured billfish from seven geographical areas within the western Atlantic Ocean.

The Third ICCAT Billfish Workshop was held in Miami, FL, July 11-20, 1996. Thirty five scientists from 7 countries submitted 19 working documents at the Workshop and these documents were presented to the 1996 SCRS meeting. Contributions from the U.S. (9 documents) included Jones and Prince (SCRS/96/96) who summarized the cooperative

tagging center recapture database for billfish. Cramer (SCRS/96/97) reported on the U.S. pelagic longline billfish catch. Jackson (SCRS/96/98) summarized the at-sea observer data aboard Venezuelan longline vessels. Judge and Farber (SCRS/96/102) reported the results of a 1994 Florida taxidermist survey of sailfish mounts. Peel et al. (SCRS/96/103) presented a summary of the first six years of The Billfish Foundation tagging program. Standardization of recreational CPUE for blue marlin and white marlin were submitted by Jones et al. (SCRS/96/104). Large pelagic logbook catch rate indices for billfish were presented by Cramer (SCRS/96/110). An evaluation of the National Marine Recreational Fishery Statistics Survey (MRFSS) was given by Nelson and Farber (SCRS/96/106). Graves and McDowell (SCRS/96/107) presented data on the genetic structure of Atlantic Istiophorid billfishes. The publication of the Third Billfish Workshop, including the data preparatory report, all working documents and assessments, will hopefully be available before the end of 1997. The Billfish Foundation provided the funds for publication of this important document in an enhanced format.

No new stock assessments were submitted to the 1995 SCRS but updated assessments for blue marlin and white marlin were accomplished at the Third Billfish Workshop and presented at the 1996 SCRS. The 1996 SCRS report on billfish concluded that the most recent stock assessments for the marlins (1996) and West Atlantic sailfish (1993) indicate that these species are either over-exploited or fully exploited and thus warrant consideration for development of methods to reduce billfish mortality at this time. Marlin and sailfish landings were revised extensively during the data preparatory meeting preceeding the Third Billfish Workshop and assessment results for blue marlin and white marlin indicated that these resources had been over exploited for about 3 decades. The Third Billfish Workshop was viewed as very successful, in part, due to the attendance of scientists from most major offshore longline fleets, particularly the Asian countries (Japan, Korea, and Taiwan). Development of management measures to reduce billfish mortality are particularly difficult because the major source of Atlantic billfish mortality results as a by-catch from the off-shore longline fleets targeting tuna and swordfish (i.e., any management measures to reduce billfish mortality in

these fisheries risk affecting the target species as well). One possible approach to reduce currently high rates of billfish longline mortality is to release, or tag and release, the billfish still alive when they are brought alongside longline vessels. Data from various observer programs indicate about 50% of these billfish appear alive when brought alongside the vessels. This type of management measure would first have to be implemented on an experimental and selective basis while additional research is conducted to determine survival rates of billfish caught and released off longline vessels. Other recommended research include evaluation of longline deployment methods to avoid or reduce the billfish by-catch. Measures to reduce billfish longline mortality would realistically have to be combined with an observer program to verify survival estimates and compliance. Application of release, or tag and release, management measures for the recreational component of Atlantic fisheries for billfish appear unnecessary because of the current Atlantic-wide practice of volunteer release policies adopted by many participating countries. Debate of these management issues at the 1995 and 1996 ICCAT Commission Meeting met with some resistance, although a management recommendation to release billfish still alive when brought alongside longline vessels did appear in the 1996 Commission Report.

**ICCAT Enhanced Research Program for Billfish**  
Highlights of 1995 and 1996 research in the western Atlantic include a total of over 30 at-sea observer trips, for the fourth and fifth consecutive year, accomplished on Venezuelan longline vessels targeting tuna and swordfish. In addition, biological sampling of swordfish for reproductive organs and swordfish for calcified structures (age and growth) were continued. Progress on shore-based sampling in 1995/6 continued with several thousand carcass measurements accomplished in both years. In addition, the ICCAT Enhanced Research Program for Billfish (ERPB) continues to make impressive progress on improving tag recapture rates of billfish. During the 1995 and 1996 sampling season, many tag recaptured billfish were recovered from Venezuelan fishermen - number of recoveries average about two dozen per quarter year. Recapture efforts also continued to result in a number of tag-recaptured sharks being reported through the Program. Expansion of tag release activities and



acquisition of hardparts for billfish age and growth studies continued in 1995/96.

#### At-Sea Sampling in Venezuela

This project involves the sampling of billfish caught on industrial longline vessels by an assigned biological technician (observer) on trips out of the Port of Cumaná. The database is comprised of fishing trips divided into sets, and organized by season. Sets are categorized into seasons: winter = (December-February), spring = (March-May), summer = (June-August), and fall = (September-November). Trips are designated as targeting yellowfin tuna or swordfish, depending on the type of bait used. Trips targeting yellowfin tuna use sardines and generally occur during the day. Trips targeting swordfish generally use squid bait, and occur in the late evening through the early morning.

Information collected by the observers includes species, time of landing, sex, various measurements and weight, and the condition of the fish (living vs. dead) when brought alongside the boat.

This program has ranged from 3 monitored trips in 1987, to a high of 37 monitored trips in 1993 (Table 9). In 1994, 320 sets were recorded for 34 trips. In the previous 1993/1994 newsletter 36 trips were recorded; however, 2 trips were later redesignated as 1995 trips due to the season category separation. Over the period 1987 - October 1995, the sampled longline vessels set an average of 1,254 hooks per set, with each set being an average of 50 km (30 miles). The total number of billfish caught during the almost 9 years was: 651 blue marlin, 1,314 white marlin, 887 sailfish, and 389 spearfish.

Table 9. Numbers of trips and sets, average numbers of hooks-per-set, and longline length-per-set (km), numbers of billfish caught, and estimated mortality of billfish brought alongside the boat for at-sea sampling in Venezuela, 1987-October 1995.

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1987-1995
No. of trips	3	3	3	7	16	32	37	34	19	146
No. of sets	23	37	34	43	99	265	488	320	201	1,510
Ave. # hooks/set	1,171	1,225	2,439	1,552	1,646	1,036	1,231	1,125	1,363	1,254
Ave. length/set (km)	57	58	42	46	39	47	50	47	67	50
No. blue marlin caught	38	13	11	34	59	87	96	174	139	651
No. white marlin caught	144	60	47	69	60	92	242	266	334	1,314
No. sailfish caught	30	7	18	19	94	148	250	144	177	887
No. spearfish caught	0	0	0	8	36	31	66	111	137	389
% blue marlin mortality	68	40	64	76	67	52	38	44	49	51
% white marlin mortality	55	55	65	56	57	65	61	55	59	58
% sailfish mortality	50	67	72	68	78	66	67	75	66	69
% spearfish mortality	N/A	N/A	N/A	75	67	61	65	61	72	67

Over the period 1987 through October 1995, there were 146 fishing trips comprised of 1,510 sets (Table 9). Of these trips, 97 were designated as targeting yellowfin tuna (or tuna - general), and the remaining 49 trips were designated as targeting swordfish (Table 10).

The number of billfish caught during 97 trips targeting tuna (sardin baits fishing during daylight hours) was 9,373, or 96.6 billfish caught per trip. The number of billfish caught during trips targeting swordfish (squid baits fished during night hours) was 3,540, or 72.2 billfish caught per trip.

A total of 174 blue marlin, 266 white marlin, 144 sailfish, and 111 spearfish were caught aboard Venezuelan longline vessels sampled by ICCAT at-sea sampling program during 1994. The average set contained 1,125 hooks on 47 km of line. Mortality rates for blue marlin, white marlin, sailfish, and

Table 10. Number of billfish caught, effort, and catch rate (in number of billfish caught per trip) by target species from the at-sea sampling program in Venezuela, for 1987 through October 1995.

Target Species	# Billfish Caught	# Trip	# Billfish Caught / Trip
Tuna	9,373	97	96.6
Swordfish	3,540	49	72.2

spearfish were reported at 44%, 53%, 75%, and 61%, respectively. The greatest average number of hooks per set and line length per set was used during the fall. The number of billfish caught during the fall was 534 or 76.8% of the 695 billfish caught during 1994 (Table 11).

Table 11. Catch summary for 1994, by species, by season, in number of fish and percent.

SPECIES	FALL		WINTER		SPRING		SUMMER		TOTALS	
	# FISH	%	# FISH	%	# FISH	%	# FISH	%	# FISH	%
Blue Marlin	135	77.7%	4	2.3%	26	14.9%	9	5.1%	174	100%
White Marlin	243	91.5%	7	2.6%	9	3.3%	7	2.6%	266	100%
Sailfish	69	47.9%	8	5.6%	16	11.1%	51	5.4%	144	100%
Spearfish	87	78.3%	—	—	18	16.2%	6	5.4%	111	100%
TOTALS	534	76.8%	19	2.8%	69	9.9%	73	10.5%	695	100%

In 1995, the billfish catch aboard Venezuelan long-line vessels sampled by the ICCAT at-sea sampling program included 139 blue marlin, 334 white marlin, 177 sailfish, and 137 spearfish. The average set contained 1,363 hooks on 67 km of line. Mortality rates for blue marlin, white marlin, sailfish, and spearfish were reported at 49%, 59%, 66%, and 72%, respectively. The greatest average number of hooks per set and line length per set was

used during the winter. The number of billfish caught during the winter was 524 or 66.6% of the 787 billfish caught during 1995 (Table 12).

All at-sea and shore-based sampling data are available upon request by writing the NMFS, SEFSC, 75 Virginia Beach Drive, Miami, FL, 33149 (attention: Dr. Eric D. Prince).

Table 12. Catch summary for 1995, by species, by season, in number of fish and percent.

SPECIES	FALL		WINTER		SPRING		SUMMER		TOTALS	
	# FISH	%	# FISH	%	# FISH	%	# FISH	%	# FISH	%
Blue Marlin	45	32.3%	63	45.3%	14	10.2%	17	12.2%	139	100%
White Marlin	35	10.5%	264	79.0%	34	10.2%	1	0.3%	334	100%
Sailfish	19	10.7%	144	81.5%	12	6.7%	2	1.1%	177	100%
Spearfish	24	17.5%	53	38.7%	33	24.1%	27	19.7%	137	100%
TOTALS	123	15.6%	524	66.6%	93	11.8%	47	6.0%	787	100%

## AGE AND GROWTH RESEARCH

A number of unusual size billfish samples were collected during 1994 and 1995. The smallest blue marlin was sampled in 1994 and measured only 25 cm lower jaw fork length. Three large blue marlin samples were collected during 1995 from fish weighing over 1,000 pounds. Additional hardpart samples were obtained from our Save it For Science Program. One blue marlin, one white marlin, and five sailfish samples were obtained from tag recaptures.

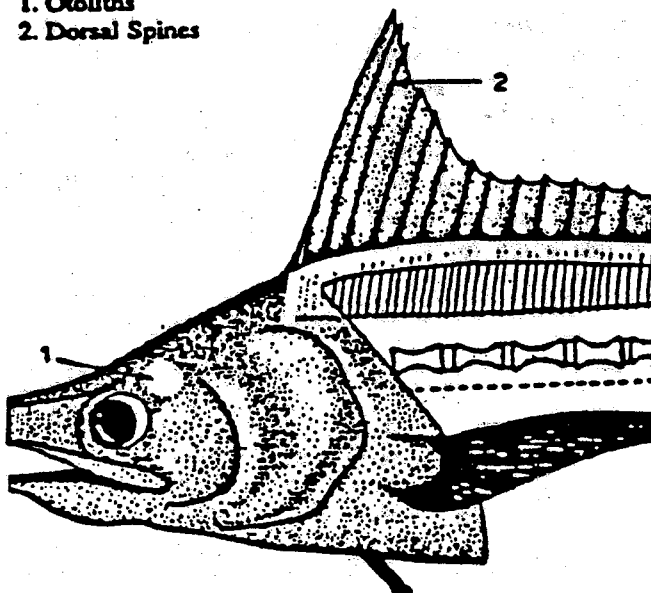
Fishery biologists use several ways to determine the age and growth of billfish, but perhaps the most widely used method is to examine their "hard" parts for annual growth rings, much as you would examine a tree trunk for its annual growth rings. The "hard" parts that are most often examined for growth or age rings on the billfish are the first six dorsal spines and the otoliths (ear bones). The reason that the hard parts are used is that calcium (or calcium-like material) is deposited in these areas during growing stages. If a major change in growth takes place, a "ring" appears in the hard parts which indicates a transfer from "fast" growth to "slower" growth.

When these skeletal parts are recovered from a recaptured tagged billfish, the hard parts are very thinly sliced and then examined under a high-powered light microscope or a scanning electron microscope to determine the growth ring pattern. Comparison can then be made between the age known from tagging records and age estimated from skeletal structural analysis. This allows fishery biologists to determine the accuracy of current ageing techniques.

Anglers catching a tagged billfish should save the whole fish (by freezing if possible) and contact Dr. Eric Prince of the National Marine Fisheries Service at (305) 361-4248 (office) or (305) 598-0944 (home) or your local fisheries agency. If it is not possible to provide the whole fish, the following sampling procedure should be followed:

1. The first five dorsal spines and the otoliths can be conveniently taken in one unit by cutting off the bill and lower jaw at the nostrils, filleting the meat away from the backbone to the fifth vertebra, and separating this from the rest of the body.
2. Cut a large area of flesh around and underneath the tag and remove this area with the tag.
3. Indicate the date and location of capture. Length measurement from lower jaw to fork of the tail in inches or centimeters and weight in pounds or kilograms at time of capture.

1. Otoliths
2. Dorsal Spines



## PELAGIC OBSERVER PROGRAM

The Pelagic Observer Program (POP), located at the NMFS, SEFSC Miami Laboratory, completed its third full year of coverage since its commencement early in 1992. The POP is continuing its coverage of the U.S. commercial longline vessels that are primarily targeting swordfish and tunas (yellowfin and bigeye).

Using the Pelagic Logbook longline set information from the previous year, a list of randomly selected U.S. vessels was generated for the northwest Atlantic region for each quarter of the current year, to provide a 5% sample of the number of longline sets made by the fleet. This list was divided between the NEFSC and SEFSC regions through 1995. In June, 1996, the SEFSC observer program was given the responsibility of covering vessels in the northeast Atlantic waters. The chance of selecting an individual vessel depends on how much fishing was reported for that vessel from the previous year. Because information is needed for each quarter of the year and over all of the fishing grounds covered by the U.S. fleet, the same vessel could be selected for observation as many as 4 times in a year. By the same procedure, a vessel might not be selected at all for any given year.

Over the period April, 1992, through 1995, a total of 235 vessels have been boarded by observers representing the NMFS Miami Laboratory. Some of these vessels have been covered more than once

during this time period, though not more than once during any given quarter. Observers spent 2,681 days at-sea aboard these vessels during this period, in which 1,476 sets were observed. Over all areas fished, the length of mainline set ranged from 4.5 nm to 40.0 nm. From 1992-95, the POP observed vessels recorded a total of 907,625 hooks, and observers identified 41,149 fish, marine mammals, and sea turtle to genus and species. In some cases, fish were released or lost at the ocean surface (mostly sharks) which the observer could only identify to a general fish group. Another report of the POP activities summarizing the 1992-95 results may be available in the spring of 1997. The POP wishes to thank the fish dealers and vessel owners, captains, and crews because these kinds of observations and measurements would not be possible without their cooperation.

### Billfish By-Catch

Billfish are hooked incidentally by U.S. longline vessels targeting swordfish and tuna in the Atlantic Ocean, Gulf of Mexico, and Caribbean Sea, as well as by other fisheries. Since October, 1988, the U.S. Fishery Management Plan for Atlantic Billfishes has prohibited the retention of billfishes by commercial fishing vessels. The numbers of billfishes caught and released from this fishery, with associated effort, are recorded on mandatory logbooks and are shown in Table 13 for 1987-1995. Effort is recorded as the number of hooks reported fished by pelagic longline sets. Numbers are revised as of October, 1996.

**Table 13.** Billfish reported caught and released by U.S. swordfish and tuna longline vessels in the Atlantic Ocean, Gulf of Mexico, and Caribbean Sea, 1987-1995. Effort is recorded as total hooks reported fished by pelagic longliners; no bottom longline effort is included.

YEAR	BLUE MARLIN	WHITE MARLIN	SAILFISH	HOOKS REPORTED
1987	2,804	2,667	1,166	6,555,512
1988	2,350	2,087	1,633	7,005,100
1989	3,159	2,892	1,538	7,827,249
1990	2,756	2,159	1,787	7,398,241
1991	2,142	2,338	1,631	7,231,236
1992	2,780	2,990	1,681	7,864,739
1993	3,202	3,276	2,359	8,866,797
1994	2,953	2,566	1,962	9,096,216
1995	2,880	3,167	1,251	10,067,556